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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/357,264	07/19/1999	FAN ZHANG	30-4790(4780	9000
34284	7590	09/17/2004	EXAMINER	
ROBERT D. FISH RUTAN & TUCKER LLP 611 ANTON BLVD 14TH FLOOR COSTA MESA, CA 92626-1931			SONG, MATTHEW J	
			ART UNIT	PAPER NUMBER
			1765	

DATE MAILED: 09/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 09/357,264	<b>Applicant(s)</b> ZHANG ET AL.	
	<b>Examiner</b> Matthew J Song	<b>Art Unit</b> 1765	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 13 November 2002.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1 and 12-43 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1 and 12-43 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

**DETAILED ACTION**

***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/13/2002 has been entered.

***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 15 recites the limitation "said coating is CeO<sub>2</sub>" in line 1. There is insufficient antecedent basis for this limitation in the claim. Claim 12, which claim 15 depends, does not recite a coating. However, claim 13 does recite a coated particle. Therefore, it is unclear if a coated particle is intended to be included in claim 12 or if claim 15 was intended to depend from claim 13. In order to further prosecution, the Examiner has interpreted claim 15 to depend from claim 13.

4. Claim 28 recites the limitation "the Ti and TiN" in line 2. There is insufficient antecedent basis for this limitation in the claim. Claim 19, which claim 28 recites a Cu/Ta/TaN and does not recite Ti or TiN. In order to further prosecution, the Examiner has interpreted claim 28 to be Ta and TaN.

***Claim Rejections - 35 USC § 102***

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 1, 12, 16-19 and 29-33 are rejected under 35 U.S.C. 102(e) as being anticipated by Kaufman et al (US 5,954,997).

Kaufman et al discloses a single chemical mechanical polishing (CMP) slurry to polish metal layers, particularly copper or copper alloy containing layers in an integrated circuit (col 4, ln 1-10) and the term copper alloy includes substrates comprising Ta/TaN/Cu multi-layer substrates (col 5, ln 1-15), this reads on applicants' single slurry solution that includes a Cu/Ta/TaN surface. Kaufman et al also discloses a preferred oxidizer used in the CMP slurry is hydrogen peroxide and compounds which upon reduction from hydroxyl radicals (col 5, ln 25-45), this reads on applicants' oxidizing reactant. Kaufman et al also discloses other well known polishing slurry additives may be incorporated into the slurry, such as sulfuric acid, phosphoric acid, nitric acid, oxalic acid, acetic acid to enhance the polishing rate of the barrier layers in the wafer, such as tantalum (col 6, ln 1-35), this reads on applicants' co-reactants.

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Referring to claim 12, Kaufman et al discloses the CMP slurry includes abrasive particles, typically a metal oxide, such as alumina, titania, zirconia, germania, silica, ceria and mixtures thereof (col 7, ln 1-20).

Referring to claim 17-18, Kaufman et al discloses a particle diameter of less than 0.4 micron (col 8, ln 1-10).

Referring to claim 19, Kaufman et al discloses the single step slurry solution including a combination of peroxide with phosphoric acid, HF acid, sulfuric acid, nitric acid, oxalic acid or acetic acid (col 4, ln 5-10, col 5, ln 25-45 and col 6, ln 1-35). Kaufman et al also discloses the CMP slurry is applied to the substrate and at least a portion of the metal layer is removed (col 4, ln 30-35). Kaufman et al also discloses the CMP slurry polishes copper, tantalum and tantalum nitride layers at good rates under controllable conditions, this reads on applicants' planarizing both the Cu and at least one of the Ta and TaN during a single processing step (col 9, ln 5-20; col 8, ln 35-45; and col 6, ln 20-35).

Referring to claims 29-33, Kaufman et al discloses peroxide, phosphoric acid, sulfuric acid, nitric acid and acetic acid.

### ***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) in view of Hampden-Smith et al (US 6,602,439).

Kaufman et al teaches all of the limitations of claim 13, as discussed previously, except Kaufman et al does not teach the abrasive particles are coated.

In a method of chemical mechanical planarization, note entire reference, Hampden-Smith et al teaches abrasive particles comprises  $\text{SiO}_2$  with a  $\text{CeO}_2$  coating. Hampden-Smith et al also teaches such coatings can advantageously provide accurate control over the particle density and can also provide control over the chemical and mechanical action of the particles during polishing (col 38, ln 1-25). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al by using the  $\text{SiO}_2$  particles coated with  $\text{CeO}_2$  to improve control over particle density and control of the chemical and mechanical action of the particles during polishing.

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9. Claims 1, 12, 16-23, 28-35 and 39-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission).

Kaufman et al teaches all of the limitations of claim 28, as discussed previously, except the step of planarizing removes the Cu and at least one of the Ta and TaN with approximately 1:1 selectivity. Admission teaches Cu/Ta/TaN CMP requires slurries with high Cu and Ta/TaN removal rates and close to a 1:1 removal selectivity between Cu and a liner metal of Ta or TaN (pg 6).

Kaufman et al teaches optional additives may be added to the polishing slurry to further improve the polishing rate of the barrier layers in the wafer, such as tantalum (col 6, ln 20-35). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al by optimizing the polishing slurry by using selecting additional additives to obtain a 1:1 removal selectivity between Cu and a liner metal, which is desirable, as evidenced by Admission.

10. Claims 36-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claims 1, 12, 16-23, 27, 28-35 and 39-43 above, and further in view of Hampden-Smith et al (US 6,602,439).

The combination of Kaufman et al and Admission teaches all of the limitations of claim 13, as discussed previously, except the combination of Kaufman et al and Admission does not teach the abrasive particles are coated.

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In a method of chemical mechanical planarization, note entire reference, Hampden-Smith et al teaches abrasive particles comprises  $\text{SiO}_2$  with a  $\text{CeO}_2$  coating. Hampden-Smith et al also teaches such coatings can advantageously provide accurate control over the particle density and can also provide control over the chemical and mechanical action of the particles during polishing (col 38, ln 1-25). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kaufman et al and Admission by using the  $\text{SiO}_2$  particles coated with  $\text{CeO}_2$  to improve control over particle density and control of the chemical and mechanical action of the particles during polishing.

11. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) or Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claim 19 above, and further in view of Pozniak et al (US 5,887,974) or Avanzino et al (US 5,916,855).

Kaufman et al or the combination of Kaufman et al and Admission teaches all of the limitations of claim 24, as discussed previously, except the slurry solution further includes at least one of  $\text{CuCl}$ ,  $\text{FeCl}$  and  $\text{FeCl}_3$ .

In a method of preparing a slurry, Pozniak et al teaches slurries are typically used in chemical mechanical polishing or planarization (CMP) and the slurries comprise potassium hydroxide, silicon oxide, an oxidizer such as hydrogen peroxide, may also contain ferric nitrate or chloride (col 1, ln 10-25). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination of Kaufman et al and Admission by using ferric chloride because it is conventional used in CMP slurries.



In a method of chemical mechanical polishing, Avanzino et al teaches the addition of ammonium chloride is desirable to stabilize the slurry of ferric nitrate and persulfate and  $\text{FeCl}_3$  could be used in place of ammonium chloride (col 12, ln 35-65). Kaufman et al teaches a variety of CMP slurry additives, such as stabilizers may be used (col 6, ln 35-45). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination of Kaufman et al and Admission by using  $\text{FeCl}_3$  to stabilize the slurry.

12. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) or Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claim 19 above, and further in view of Cronin et al (US 6,143,640) or Carpio (US 5,846,398).

Kaufman et al or the combination of Kaufman et al and Admission teaches all of the limitations of claim 25, as discussed previously, except the slurry solution further includes at least one of  $\text{Cu}(\text{NO}_3)_2$ ,  $\text{CuSO}_4$ , EDTA,  $\text{FeNO}_3$ , KOH,  $\text{K}_2\text{S}_2\text{O}_5$ ,  $(\text{NH}_4)_2\text{S}_2\text{O}_8$ ,  $\text{CuNH}_4\text{Cl}_3$ , NaOH,  $\text{NaClO}_3$ ,  $\text{NaNO}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_8$ ,  $\text{NH}_4\text{F}$  or  $\text{NH}_4\text{OH}$ .

In a method of planarizing a copper layer, Cronin et al teaches chemical mechanical polishing of a copper layer utilizing an ammonium persulfate/potassium hydroxide slurry (col 6, ln 5-25).

Kaufman et al teaches other well known polishing slurry additives may be incorporated, such as potassium salts (col 6, ln 20-35). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination

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of Kaufman et al and Admission by using potassium hydroxide, as taught by Cronin et al, as an additive to the copper planarization.

Carpio teaches a CMP slurry for copper metal layers comprising at least one oxidant capable of forming a passive oxide, such as ferric nitrate, ammonium peroxydisulfate, alkali or metal peroxydisulfate salts, iodates, bromates or chlorates (col 4, ln 30-60). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination of Kaufman et al and Admission by using the oxidizer taught by Carpio because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

13. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) or Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claim 19 above, and further in view of Ohmori et al (US 5,639,363).

Kaufman et al or the combination of Kaufman et al and Admission teaches all of the limitations of claim 26, as discussed previously, except the slurry solution further includes at least one of a molybdenum salt and phenosulfonic acid.

In a method of mechano-chemical polishing, Ohmori et al teaches an inorganic salt is an alkaline metal salt of one of carbonate, silicate, and molybdate and contains cations of molybdenum, sodium or potassium. Ohmori et al also teaches it is preferable that the anion comprise at least one of chlorine ion, nitrate ion, or sulfate ion (col 4, ln 10-30).

Kaufman et al teaches slurry additives may be incorporated, such as cationic salts of sulfates, phosphates and fluorides (col 6, ln 20-35). Therefore, it would have been obvious to a

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person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination of Kaufman et al and Admission by using the cationic salt taught by Ohmuri et al to produce an expected result.

### ***Response to Arguments***

14. Applicant's arguments with respect to claims 1 and 12-43 have been considered but are moot in view of the new ground(s) of rejection.

### ***Conclusion***

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Ueda et al (US 5,697,992) teaches cerium oxide may be adhered to or coated on the surface of an abrasive particle to improve the polishing rate without causing scratches and orange peels (col 3, ln 20-35).

Small et al (US 2002/0111024) teaches a composition of a polishing slurry using oxidizer for copper and tantalum and using nitric, sulfuric and citric acid ([0048],[0032]).

Zhang et al (US 6,630,433) claims similar subject matter and was filed after the instant application.

Zhang et al (US 2002/0020833) claims similar subject matter and was filed on the same day as the instant application.

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16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song  
Examiner  
Art Unit 1765

MJS

**NADINE G. NORTON**  
**SUPERVISORY PATENT EXAMINER**

